UNIVERSITI PUTRA MALAYSIA

BIOLOGI AND CONTROL OF WHITE ROOT DISEASE OF HEVEA RUBBER CAUSED BY RIGIDOPORUS LIGNOSUS (KLOTZSCH) IMAZEKI

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BIOLOGY AND CONTROL OF WHITE ROOT DISEASE OF *HEVEA* RUBBER CAUSED BY *RIGIDOPORUS LIGNOSUS* (KLOTZSCH) IMAZEKI

by

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January 1987

Supervisor : Prof. George Varghese

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White root disease is by far the most serious among the three major root diseases of rubber. Current methods of control of the disease include pre-planting control procedures, such as mechanical or hand clearing, sulphur amendment, use of covers and intercrops; post-planting control procedures, i.e. disease detection, treatment with collar protectant dressing; the use of isolation trenches in mature rubber; and more recently the application of Calixin emulsion as soil drench.

High costs of labour and chemicals, however, made these methods rather expensive, not to mention the serious hazard chemicals pose to the environment.

This study explored some possible methods of white root disease control which minimize, if not completely avoid,

dependency on chemicals. Such methods as introduction of antagonists, application of chemicals at minimal rate and addition of organic matter supplement applied either individually or in combination with each other were included in the study.

Results demonstrated that chemically assisted biological control against white root disease could be achieved with combined application of the different treatments. It was also evident that the inclusion of antagonists and cow manure in the treatments further enhanced increase of population of the mycoflora. Fifty percent of the treatments with total population of mycoflora significantly higher than that of the control included both antagonists and cow manure.

Sulphur as a single treatment had likewise achieved good results in terms of enhancing population growth of the mycoflora, and consequently *Trichoderma* spp. Treatment 24 (Sulphur alone) had always resulted in a significantly higher (1% level) population over that ofthe control (T_0).

With the enhancement of the activity of the soil mycoflora, especially *Trichoderma* spp., by one or a combination of the different treatments, survival of propagative units and consequently, the activity of *R. lignosus* as a whole is adversely affected. Results in field inoculation with the pathogen supported this contention. Disease rating of inoculated roots was rather low and and percentage recovery in previously infected trees was high (70%) while an overall increase in population of the mycoflora was noted.

Preliminary findings on the morphology and physiology of *R. lignosus* tend to point out that variations among isolates of the pathogen exist. This could be a very relevant area of study in future thrusts of research as nothing has so far been done along this line in this region of Southeast Asia. It is most likely that along with variations in these characteristics there also exist variation in pathogenicity of *R. lignosus*. A knowledge along this line, therefore, would be an invaluable help to plant protectionists and agronomists alike in planning out researches especially in the areas of disease resistance.

Abstrak tesis yang diserahkan kepada Senat Universiti Pertanian Malaysia sebagai memenuhi sebahagian dari syarat yang diperlukan untuk mendapatkan Ijazah Master Sains Pertanian.

BIOLOGI DAN KAWALAN PENYAKIT AKAR PUTIH GETAH *HEVEA*

DISEBABKAN OLEH *RIGIDOPORUS LIGNOSUS* (KLOTZSCH) IMAZEKI

oleh

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Januari 1987

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Penyakit akar putih merupakan penyakit yang paling serius diantara ketiga-tiga penyakit utama akar getah. Kaedah-kaedah pengawalan semasa untuk penyakit ini termasuk prosedur-prosedur pengawalan sebelum menanam, seperti pembersihan secara mekanikal atau tangan, imbangan belerang, penggunaan tanaman penutup dan selangan; prosedur-prosedur pengawalan selepas menanam, iaitu pengesanan penyakit, rawatan dengan "collar protectant dressing"; menggunakan parit pemisah dalam getah matang; dan baru-baru ini penggunaan emulsi Calixin sebagai basahan tanah.

Harga buruh dan kimia yang tinggi, walau bagaimanapun, membuatkan kaedah-kaedah ini mahal, disamping masalah pencemaran persekitaran akibat penggunaan kimia.

Kajian ini mencari serta meneliti kaedah-kaedah pengawalan penyakit akar putih yang boleh mengurangkan, jika tidak terus mengelakkan penggunaan kimia. Kaedah-kaedah seperti pengenalan antagonis, penggunaan kimia-kimia pada kadar minimum dan penambahan jirim organik samada bersendirian atau dalam campuran dengan satu sama lain dimasukan dalam kajian ini.

Keputusan menunjukkan yang kawalan biologi bantuan kimia terhadap penyakit akar putih boleh dicapai dengan penggunaan bersama rawatan-rawatan yang berbeza. Juga jelas didapati penambahan antagonis yang baja binatang dalam rawatan-rawatan meninggikan lagi populasi mikoflora. Lima puluh peratus daripada rawatan-rawatan dengan ketinggian bererti daripada kawalan menggunakan kedua-dua antagonis dan baja binatang.

Belerang sebagai rawatan tunggal memberi keputusan yang baik dari segi menggalakkan pertumbuhan populasi mikoflora, dan seturusnya *Trichoderma* spp. Rawatan 24 (belerang sahaja) sentiasa memberi keputusan ketinggian populasi yang bererti (aras 1%) daripada kawalan (T_0).

Dengan penambahan keaktifan mikoflora tanah, terutama sekali *Trichoderma* spp., oleh satu atau kombinasi rawatan-rawatan yang berbeza, kemandirian unit-unit propagatif dan seterusnya, keaktifan *R. lignosus* pada keseluruhannya terjejas. Keputusan inokulasi diladang dengan patogen menyokong pendapat ini. Penilaian penyakit akar-akar yang diinokulat agak rendah dan peratus baik semula dalam pokok-pokok yang telah dijangkiti adalah tinggi (70%), manakala penambahan dalam populasi mikoflora pada keseluruhannya jelas.

Keputusan-keputusan awal tentang morfologi dan fisiologi *R. lignosus* menunjukkan kedapatan variasi diantara isolat-isolat patogen. Ini mungkin menjadi satu aspek kajian dimasa akan datang kerana masih belum ada usaha dijalankan didalam bidang ini di Asia Tenggara. Besar kemungkinan disamping variasi dalam ciri-ciri ini terdapat juga variasi dalam patogenisiti *R. lignosus*. Pengetahuan, oleh itu, didalam aspek ini akan memberi pedoman yang baik kepada pegawai-pegawai perlindungan tumbuhan dan agronomi dalam merancang penyelidikan terutama sekali dari resistans penyakit.

CHAPTER I

INTRODUCTION

The rubber tree (<u>Hevea</u> <u>brasiliensis</u> Muell-Arg.) belongs to the Family Euphorbiaceae. Believed to be a native of the tropical forests of South America, the introduction of the rubber tree to Malaysia was made in 1876 via the Wickham collection from the Amazon valley. The first nine seeds were planted in the Malay Peninsula by H.J. Murton in the gardens of the British Residency in Kuala Kangsar, Perak on 31st October, 1877. At that time only vision and not much else would have led people to plant the slow-growing rubber to supplement or replace the then lucrative coffee as a crop. The vision of Henry Nicholas Ridley, who pioneered the establishment of rubber plantations in Malaysia as early as 1888, was one good example. Nicknamed "Madman Ridley" for persuading planters to plant rubber, his efforts were rewarded with John Boyd Dunlop's discovery of the pneumatic tyre and the advent of the faster automobile industry. What was once the object of idle curiosity to the eccentric botanist suddenly became a main source of industrial material of immense value. Rubber thus began to be planted on large scale and the record of its expansion in Malaysia was phenomenal, running a close parallel to the development of the automobile industry of the world (MRRDB, 1985).

The discovery of the vulcanization process transformed <u>Hevea</u> into a very important plant as it now supplies the increasing demand for natural rubber in the various industries. It is estimated that the world's growth demand for the total natural elastomers is 7% per year while that of the synthetic isoprenic type is only 4% (Ani, 1974; Allen et al, 1974 and Ariffin, 1977). The estimated world's demand for the total elastomer is 19 million tonnes and is expected to increase to 24 million tonnes by 1990 (Leong, 1979). Based on projections from authoritative sources, Ng (1985) reported that the market for elastomers, i.e. both natural rubber (NR) and synthetic rubber (SR), is seen to continue to expand at a moderate rate till the year 2000 and possibly beyond (Table 1.1). He further stated that although the market share of NR continues to diminish due mainly to the more rapid expansion by the SR sector, in absolute terms, the NR market continues to expand. Mohd Nor (1979) reported that the future prospects of natural rubber appear to be better compared to that of the synthetic. This is due to oil price increases and the International Rubber Price Stabilization Agreement between the producer and consumer countries.

The rubber tree has spread throughout the world with Malaysia having nearly 2 million hectares, 1.7 million ha. of which are in Peninsular Malaysia (Salleh, 1984), Indonesia with more than 2.3 million ha and Thailand over 1.4 million ha. (Mohd Nor and Salleh, 1984). While rubber is considered a minor crop in the Philippines, it has high export potential and rubber production is one of the most profitable agro-industrial ventures (PCARRD, 1982). The reported area planted to rubber trees in the Philippines as of 1985 is 60,000 ha. (USM-CMU, 1985). It is projected that rubber area may increase

TABLE 1.1

WORLD NR PRODUCTION AND CONSUMPTION
PROJECTIONS FOR 1985-2000

Source	Projections ('000 tonnes) 1985	1990	1995	2000
Rubber Task Force (1983)				
NR + SR Consumption	13,600	15,500	-	18,000
NR Share (%)	-	32.3	-	33.3
NR Consumption	-	5,000	-	6,000
NR Production	4,428	4,774	5,387	6,113
Balance		-226		+113
IRSG (1984)				
NR + SR Consumption	13,918a	16,652		
NR Share (%)	31.8	30.9		
NR Consumption	4,419	5,150		
NR Production	4,056	4,554		
Balance	-363	-596		
World Bank (1984)				
NR + SR Consumption	13,149	16,401	19,920	
NR Share (%)	32.3	30.5	28.6	
NR Consumption	4,240	5,000	5,700	
NR Production	4,242	5,000	5,700	
Balance	+2	0	0	
H. P. Smith (1983)				
NR + SR Consumption	14,653	17,450	20,108	23,092
NR Share (%)	30.9	29.7	26.7	26.1
NR Consumption	4,530	5,183	5,370	6,030
NR Production	4,428	4,783	5,318	6,149
Balance	-102	-400	-52	+119
IISRP (1985)				
NR + SR Consumption	12,600	13,976b		
NR Share (%)	33.1	32.9		
NR Consumption	4,166	4,599		

a Projection for 1986

b Projection for 1989

(Source: Ng, 1985)

tremendously within the next few years since there are about 0.5 million ha of potential rubber areas in Mindanao. The total area planted to rubber in the world is nearly 7.5 million ha with 6.9 million ha being in tropical Asia (Mohd Nor and Salleh, 1984).

Malaysia is the world's largest producer of natural rubber. Rubber is the major export commodity that makes up over a quarter of Malaysia's gross exports and contributed 15% to its GNP (Tan, 1983). The industry provides employment to about one-third of Malaysia's economically active population.

The rubber production of Malaysia for 1985 was expected to reach 2.7 million tonnes and based on the estimates made by RRIM (Table 1.2), Malaysia has to produce 3.10 million tonnes by 1990 and 3.78 million tonnes by the year 2000 in order to maintain its current 45% share in the world's natural rubber market. This increase in production over time has to be achieved by increasing the yield of existing areas under rubber and by opening up new areas for rubber planting (Mohd Nor, 1979). The second alternative, however, may not be as feasible as it had appeared to be during the past decade. Lately, reports indicated that total area planted to rubber has substantially declined due to conversion of rubber land to oil palm cultivation (Mohamad, 1985). This, he added, is due to better returns offered by oil palm production as compared to rubber production. Moreover, there is a growing awareness and concern with labour problems: increasing labour shortage and consequently wages.

TABLE 1.2

ESTIMATED AREA COVERAGE REQUIRED TO MAINTAIN MALAYSIA'S MARKET SHARE OF NR PRODUCTION AND NR SHARE OF THE ELASTOMER MARKET

Year	Total Elastomer (million tonnes)	Market Share for NR (million tonnes)[a]	Malaysia's production share (million tonnes)[b]	Estimated tapped area ('000 ha)[c]	Additional area required ('000 ha)[d]
1985	18.5	5.55	2.50	2000	+ 285
1990	23.0	6.90	3.10	2385	+ 670
1995	25.4	7.62	3.42	2533	+ 818
2000	28.0	8.40	3.78	2700	+ 985

a 30% of the total elastomer

b 45% of NR market

c assumed a yield of 1200 kg per ha in 1980 and 4% increase per year

d after deduction of 1,715,000 ha, the assumed present tapped area

(Source: Mohd Nor, 1979)

The decline in total rubber area has implications for productive capacity. Actual production would fall when incremental production from higher yielding varieties is less than the loss of production due to the reduction in area. As a result, the industry as a whole may not be able to meet future expected demand (Mohamad, 1985). This necessitates more efficient utilization of existing resources as this is probably more economical compared to bringing new land into production. Steps should be taken to alleviate the constraints facing the rubber industry in order to improve expected profitability from rubber production, i.e. employing measures to reduce cost per unit of production.

Among several factors that contribute to rubber yield performance are: soil physical and chemical properties, high yielding clones and level of management - including disease control. Proper utilization of these factors, coupled with good price of NR in the market, would certainly lead to greater productivity in the rubber industry.

Several diseases of the rubber tree are of economic importance as they directly or indirectly affect yield of latex. The severity of the individual disease varies widely in different localities depending upon local factors such as weather, topography and altitude (Tan and John, 1985).

In Malaysia, a report by Tan and John (1985) showed that control of the major rubber diseases in the field could go as much as M$655 per hectare per year. This figure excludes cost of control of nursery diseases, which when severe could go as high as M$1,000 to M$1500 per hectare per year, and root diseases which was estimated at M$6 per tree.

Root diseases are important in the immature phase of rubber cultivation. Unlike leaf and stem diseases, it is the only disease of rubber which kills the tree if left untreated. At the present moment when prime mature rubber is valued professionally at M$4,875.00 per tree and immature rubber at M$3,300.00 per tree in West Malaysia (Montgomery, 1984), any measure to minimize, if not prevent, tree loss is all the more rewarding.

Most important among the root diseases of rubber is white root disease caused by Rigidoporus lignosus (Klotzsch) Imazeki. According to Rubber Research Institute of Malaysia (1974), white root disease is the earliest to appear in a stand, usually about a year after planting, and accounts for more tree losses than those caused by the slower spreading red and brown root diseases together (Plate I). Current methods of control of the disease (RRIM, 1980) comprise pre-planting control procedures, i.e. by mechanical clearing or hand-clearing, sulphur amendment, use of covers and intercrops; post-planting control procedures, i.e. disease detection, treatment with collar protectant dressing; and the use of isolation trenches for root disease control in mature rubber.

These methods, however, aside from being expensive, are labour-intensive. Moreover, like control methods of leaf and stem diseases, they rely mainly on chemicals, the effect of which is temporary and therefore require repeated applications. Aside from posing hazard of environmental pollution, repeated applications would only mean additional cost which, in the current situation, is not desired.

PLATE I. A DISEASE PATCH IN A PREVIOUSLY WHITE ROOT DISEASE-INFECTED AREA